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**WHY THE MARRIAGE SQUEEZE CANNOT CAUSE
DOWRY INFLATION**

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Why the Marriage Squeeze Cannot Cause Dowry Inflation*

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Abstract

It has been argued that rising dowry payments are caused by population growth. According to that explanation, termed the ‘marriage squeeze’, a population increase leads to an excess supply of brides since men marry younger women. As a result, dowry payments rise in order to clear the marriage market. The explanation is essentially static; unmarried brides do not re-enter the marriage market. This paper demonstrates that the marriage squeeze argument cannot explain dowry inflation in a proper dynamic framework. In fact, when women, who do not find matches at the ‘desirable’ marrying age, re-enter the marriage market as older brides, (as is the case in areas undergoing dowry inflation), the marriage squeeze argument is shown to imply dowry deflation.

JEL Classification Codes: J11, J12, J16, D10

Keywords: dowry, population growth, marriage

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1. Introduction

There is considerable evidence that real dowry payments, that is, the transfer from brides and their families to grooms at the time of marriage, have risen over the last five decades in South Asia.¹ These payments are substantial and can amount to roughly six times a household's annual income (Rao 1993a). The severe social consequences of rising dowries have motivated a large body of research aimed at explaining the phenomenon.² A particularly influential and intuitive explanation is one based on a process demographers term the "marriage squeeze" (see, Rao 1993a and 1993b, Caldwell et. al. 1983, Billig 1992, and Lindenbaum 1981).³ This marriage squeeze explanation relies on the fact that, in a growing population where grooms marry younger brides, grooms will be in relatively short supply in the marriage market. Since brides reach marriageable age ahead of grooms, increases in population impact upon brides first, thus causing an excess demand for grooms and an increase in the price of husbands, i.e., dowry payments rise. Though Rao (1993a and 1993b) was the first to introduce the marriage squeeze argument to economists, it is not the first mention of the phenomenon. In fact, Aristotle forwarded a form of the argument to explain the rise in the value of dowries in ancient Sparta, as explained in Hughes (1985). Herlihy (1976) and Quale (1985) similarly advance this hypothesis to explain rising dowries in medieval Europe. In the same vein, Heer and Grossbard-Shechtman (1981) argue that the marriage squeeze in the United States in the 1960s and 1970s reduced the "compensation" husbands were obliged to give wives for performing their traditional domestic duties.

In contrast, this paper argues the marriage squeeze cannot explain dowry inflation. The argument can be summarized in the following three points: (1) the marriage squeeze argument can indeed explain dowry inflation in a static framework; however, (2) the marriage market should be modelled as dynamic as it includes a form of 'storage', since women and men who do not marry

¹The empirical evidence of Rao (1993a and 1993b) and Deolalikar and Rao (1990) documents the real escalation in dowries already recognized by other social scientists. See, for example, Epstein (1973), Srinivas (1984), Paul (1986), Bradford (1985), and Upadhyaya (1990) in the sociological literature.

²The total cash and goods involved are so large that the dowry payment can lead to impoverishment of the bridal family. This has a devastating effect on the lives of unmarried women who are increasingly considered stringent economic liabilities. For example, the custom of dowry is often linked to the practice of female infanticide. Other repercussions include extreme abuse of women as evidenced by terms like "bride-burning" and "dowry-death" becoming commonly used. The links to dowry inflation have been drawn by sociologists; for example, Kumari (1989), Chauhan (1995), McCoid (1989), Pawar (1990), Lata (1990), and Pathak (1990) address these issues.

³Rao (1993a) provides an analytical foundation for this marriage squeeze explanation and provides empirical support for the argument. Since Rao's paper, the marriage squeeze has served as the central explanation for dowry inflation in the hands of economists.

in one period can delay marriage and re-enter the market later (albeit at an older age); but (3) in such a dynamic setting, the marriage squeeze argument cannot explain dowry inflation, in fact it predicts just the opposite.

This paper does not dispute the preconditions of the marriage squeeze explanation. That is, when women marry younger than men, in an increasing population, there will be an excess supply of brides. The difference comes in considering what happens to brides who do not marry at the earliest marriageable age. One possibility, with monogamous marriage customs, is that fewer women would eventually marry.⁴ Another possibility is a narrowing in marriageable ages between grooms and brides. Either the average marrying age of brides increases (some postpone marriage), or that of grooms falls (some grooms marry younger), so that the difference between the ages of spouses declines. In much of South Asia, this has been the primary equalizing mechanism in response to population growth: the average age of women at marriage has risen while that of men has remained relatively stable.⁵

But, for a bride to delay marriage is costly. The fact that women typically marry younger than men implies that there is necessarily a benefit in doing so. Conceivably younger women are preferred due to their longer reproductive life, or as in many societies, where women are considered a financial burden, parents incur an economic cost housing an older unmarried daughter. In any case, there necessarily exists some form of costs to brides marrying older than the “desirable” marrying age. The marriage squeeze argues, these costs lead older potential brides to outbid the families of younger brides, which places upward pressure on real dowries (see, for example, Rao 1993a).

However, it will be demonstrated in the paper, that even though older brides do make higher dowry payments than those younger, the effect of an excess supply of brides can only be downward

⁴In reality, however, the South Asian experience of dowry inflation, for example, has been accompanied by no discernible change in the proportion of women marrying. Rao (1993a) reports that 99% of men are married by the age of 25 and 99% of women are married by the age of 20.

⁵See, for example, Caldwell et. al. (1983), Rao (1993b), and Foster and Khan (1994). In the sample that Rao (1993a and 1993b) studies, the mean age of marriage for women has increased by 4.3 years during a 50 year period and that of men has increased by 1.9 years. Most societies are characterised by persistent differences in ages of spouses, with men, on average, marrying younger women (see, for example, Casterline et. al. 1986). The term “marriage squeeze” refers to a decrease in this marriage age-gap with population growth. Generally it is found that the marriage squeeze has little effect on the proportions ever marrying but does substantially alter the age composition within marriages, where it is typically womens’ age at marriage which adjusts upwards (see, for example, Schoen 1983). There is a large sociological literature on the marriage squeeze phenomenon, see, for example, Akers (1967), Schoen and Baj (1985), and Schoen (1983).

sloping time path of dowry payments, not inflation. The result follows from the two features just discussed: (1) that women who do not marry at the desirable age, re-enter the marriage market when older, and (2) there are costs to doing so.

Before setting up the general model, the next section briefly contrasts the static and dynamic setting of the marriage squeeze argument. The following section then provides a more general model of dowry payments. Equilibrium prices are solved for in the bench-mark case of no population growth in Section 4. Marriage market equilibria when there is increasing population, are subsequently characterised. Robustness of this result is discussed in Section 6 and Section 7 concludes.

2. A Simple Model

To see the intuition behind the argument in this paper consider the simplest possible framework in which only 1 bride and 1 groom reach marriageable age in each period. If the bride marries at marriageable age she receives a benefit of m and if the groom does so he receives n , remaining unmarried yields 0 for both.

The Marriage Squeeze Argument

With neither side of the market in excess supply, the division of surplus arising through marriage can be divided arbitrarily. This is done through a (perhaps negative) dowry payment d which divides up the surplus to marriage ($m + n$), so that $-n \leq d \leq m$. For concreteness, and since it is not the purpose of this paper to explain the existence of dowry payments, assume $d \geq 0$, though nothing hinges on this.

The marriage squeeze argument essentially examines what occurs to this payment when brides are in excess supply. So now suppose that there are two potential brides instead of one in each period, and that the woman who does not marry at marriageable age never does so. Since there is only one groom, the brides will bid up the dowry payments so that the one who marries is indifferent between marrying and remaining single. Thus d will equal m in equilibrium and, as the marriage squeeze argument predicts, there is dowry inflation.

A Dynamic Counter-Argument

The marriage squeeze argument is essentially static, it does not matter whether we consider the above only for a single period, or a number of periods. For the model to be truly dynamic, it should

be possible for individuals to alter the marriage decision intertemporally. So now suppose that an option for a bride who does not marry at the marriageable age is to wait a period and marry in the next instead. As discussed in the introduction, there are costs associated with marrying later. Since m is the benefit to marrying at the ideal age, denote the benefit to marrying in the next period $m' < m$. Now, in any period when there is excess supply of brides, competition between them implies that the brides who marry must be indifferent between marrying and delaying a period. Thus, brides compete until dowry payments are at the point where brides obtain equal utility whether they marry now or later. Given that the benefit to marrying later is less than the benefit to marrying now, i.e., $m' < m$, brides can only be indifferent between these two situations if dowry payments in the later period are lower. Thus an excess supply of brides can only be consistent with a downwards sloping time path of dowry payments, i.e., there is dowry deflation.

The simple intuition of the marriage squeeze argument only makes sense if the excess supply of potential brides never marry (i.e, the marriage market is static). If instead, in response to an excess supply of brides, some postpone marriage (i.e, the marriage market becomes dynamic), as occurs in reality, then an excess supply of brides can only lead to declining dowry payments. The argument above is extremely simple and has assumed away a number of complicating factors, such as costs to the grooms from marrying older brides and competition between older and younger brides. In the next section of the paper, a more general model encompassing these concerns is developed. As will be seen, such generalizations do not affect the result.

3. The Model

Time is discrete and in each period an equal number of males and females are born. Agents of each sex are ex-ante identical in all respects and will all eventually reach marrying age. For exogenous reasons, as discussed above, the minimum permissible age at which brides marry is lower than that of grooms. Potential brides and grooms are marriageable if their ages fall within the ranges $[b, \hat{b}]$ and $[g, \hat{g}]$ respectively, where $g > b$.⁶ Costs associated with remaining unmarried beyond the earliest marriageable age render it preferable for brides and grooms to marry at b and g , respectively.⁷

⁶One can think of age b denoting an acceptable level of sexual maturity for reproduction and age \hat{b} the point at which women are no longer adequately fertile. For husbands, g may denote an age at which men have acquired a sufficient level of human capital, reasonably, $g > b$.

⁷Since marriage is patrilocal, in the areas experiencing dowry inflation, that is, brides join the household of their grooms upon marriage, the most obvious cost to marriage delay for a bride is the additional financing of her livelihood

From the perspective of brides, these costs are increasing with their age, and in a convex manner.⁸ In addition to costs on the side of brides, there is also direct evidence that grooms prefer younger to older brides.⁹

For simplicity, the benefits and costs of marriage are modelled in a highly stylized way. Unmarried grooms receive a lifetime utility normalized to 0. Brides' families, on the other hand, incur a lifetime cost to keeping an unmarried daughter which varies according to income, denoted $-\overline{U}(y)$. All desirable qualities of a potential spouse other than age are held constant.¹⁰ For simplicity, it is assumed that all benefits and costs of marriage occur in one period only and individuals do not discount the future.¹¹ Dowry payments, denoted by d , are a transfer from brides' families to those of grooms. These payments are derived endogenously and, as will be established, may potentially vary with the period in which marriage takes place, τ , the time beyond earliest marriageable age that a bride marries, denoted t , and the income of bridal family, y , that is $d(\tau, t, y)$. So, for example, a bride of family income y marrying in period $\tau = 4$ at age $b + 2$, has dowry payment denoted $d(4, 2, y)$.

The discussion above suggests that the disutility costs of an older bride are experienced by both the bride and the groom, and hence a bride's age should affect the utility of brides and grooms directly; that is, independently of dowry payments. For brides, this is denoted as a cost, $c(t)$, which is increasing and convex in t ; $c'(t) > 0$ and $c''(t) > 0$, while for grooms it is denoted $k(t)$,

absorbed by her parents (see, for example, Lindenbaum 1981). More indirectly there are the social costs associated with marrying beyond the socially acceptable age levels for both brides and grooms, however the rules are far more stringent for women. Caldwell et. al. (1982 and 1983), for example, discuss such moral and religious codes which are explicitly linked to the sexual maturity and reproductive capabilities of both brides and grooms. It should be noted that all of the results of the model are obtained if instead the optimal marrying ages, b and g , are comprised of a range of ages, for example 15 to 20 years (see Anderson 1999).

⁸Given the stress on early marriages for females, which is a predominant feature of traditional marriages in the areas where dowry is practiced (see, for example, Goyal 1988), together with an "unmarriageable age" at the upper band (see, for example, Forbes 1979), one would anticipate convex costs to delay as the age of brides approaches this critical value, \hat{b} . In any case, only the existence of increasing costs to delay, are crucial to the analysis and the results do not require these costs to be convex. The assumption of convexity is used only to explain why the age of marriage of brides increases only gradually in the context of population growth. Without convexity in the costs to delay, brides who postpone marriage due to population growth, could wait several years before marrying.

⁹See, for example, Forbes (1979), Rao and Rao (1979) and, Kaliappan and Reddy (1987).

¹⁰This is to focus on the link between *real* dowry inflation and population growth. In reality prices vary greatly by characteristics of grooms, but the observed dowry inflation has cut across all characteristics and the marriage squeeze argument does not consider these differences. We will see that introducing variation across grooms does not affect the results here. The decision to participate in the marriage market is not modelled here. It is implicitly assumed that the benefits of marriage outweigh the costs.

¹¹It will be seen that discounting does not affect the main result.

where $k'(t) > 0$ and $k''(t) \geq 0$. For simplicity assume also that $c(0) = k(0) = 0$.¹² Grooms also experience disutility from marrying at an older age; this cost is represented by $q(i)$, where $g + i$ denotes their marrying age, $q'(i) > 0$, and $q(0) = 0$.¹³

A convenient quasilinear specification of utility yields a relatively simple expression for a bride's utility given marriage in period τ at age $b + t$:

$$U(\tau, t, y) = -d(\tau, t, y) - c(t), \quad (3.1)$$

recalling that these effects are captured in a single period only.¹⁴ Similarly, a groom's utility benefit in period τ from marrying, at age $g + i$, a bride who is aged $b + t$ is:

$$V(\tau, t, i) = d(\tau, t, y) - k(t) - q(i). \quad (3.2)$$

4. No population growth equilibrium

As a benchmark, population is initially constant through time: in each period, N brides of age b and N grooms of age g enter the marriage market. In a rational expectations equilibrium, all agents correctly anticipate realized population trajectories and the time paths of equilibrium dowry prices, $d(\tau, t, y)$ for all τ , t , and y . A dynamic equilibrium is a set of prices $\left[d(\tau, 0, y), d(\tau, 1, y), \dots, d(\tau, \widehat{b} - b, y) \right]$ with $-\infty < \tau < +\infty$, such that no individual would prefer to marry at a time or an age other than their equilibrium age under this set of prices. Future prices impinge on the current decision to marry since, if prices are anticipated to change, individuals may prefer to defer marriage until they are older in order to benefit from price movements. Brides prefer not to delay marriage if and only if:

$$U(\tau, 0, y) \geq U(\tau + 1, 1, y) \quad (4.1)$$

¹²The costs, $k(t)$, are imposed only to coincide with reality. In particular, $k(t)$ implies that older brides pay higher dowries than younger brides in any given period. Alternatively, if $k(t) = 0$ for all t , then all brides of all ages would make identical dowry payments in each period, but a decreasing time path of dowry payments would persist.

¹³Throughout the analysis, there is no variation in the age of grooms, as it is brides' age of marriage which increases when population growth occurs. Therefore, dowry payments are independent of i . The results would not change if a groom's age did enter directly into the utility of brides. Moreover, costs $q(i)$ are not crucial to the analysis at all. However, because there exists a desirable age of marriage for grooms, g , (which is given exogenously), there must exist costs for grooms who marry older than g , i.e., $q(i)$. Therefore, costs $q(i)$ are assumed only to rationalize why grooms marry at age g instead of older.

¹⁴Note that since marriages are typically arranged by the parents of both the bride and the groom in dowry paying societies, the utility of a bride represents that of her parents as well, and likewise for grooms. For simplicity, the two parties are referred to as bride and groom respectively.

Since the costs to delay are increasing and convex, conditions ruling out delay for one period are sufficient to rule it out for longer periods. Additionally, an equilibrium where neither brides nor grooms have incentive to delay requires that grooms do not prefer to match with brides who have delayed marriage:

$$V(\tau, 0, 0) \geq V(\tau, 1, 0) \quad (4.2)$$

Grooms will not delay themselves provided:

$$V(\tau, 0, 0) \geq V(\tau + i, 0, i) \quad (4.3)$$

for all $i \geq 1$.

With a stationary population, there clearly exist many equilibria in which all individuals marry at the earliest possible age, that is:

Proposition 1. *With zero population growth, and under rational expectations, an equilibrium exists in which all individuals marry at the earliest permissible age, g and b for grooms and brides respectively. The time path of dowry payments consistent with such an equilibrium necessarily satisfies:*

$$d(\tau + 1, 0, y) \in [d(\tau, 0, y) - k(1) - c(1), d(\tau, 0, y) + q(1)] \quad (4.4)$$

for all time periods τ .

Corollary 1. *A constant time path of dowry payments, $d(\tau + 1, 0, y) = d(\tau, 0, y)$, is an equilibrium.*

The restriction (4.4) is required to ensure that neither party has incentive to delay, and is obtained from equations (4.1) to (4.3). Note that since equal numbers of brides and grooms enter the marriage market each period, no one has incentive to delay and all people are married at the minimal marrying ages, g and b . Since all grooms are identical and all brides find matches, wealthier bridal parents have no incentive to offer a higher payment than those with less income. As a result, equilibrium dowry payments which satisfy (4.4) are determined according to the income of the brides with the poorest parents.

In general, when all women eventually marry, equilibrium dowry payments are determined by the poorest bridal parents. Equilibrium dowry payments are thus independent of the income

distribution across brides, as long as that of the poorest remains constant.¹⁵ For this reason, the analysis to follow abstracts from the income component of dowry payments and compresses the notation to $d(\tau, t)$.

Equilibrium payments in a given period cannot be precisely determined without adding more structure to the basic framework which would explicitly divide the marriage surplus. Equation (4.4) describes a range of possible transfers for which both parties strictly prefer marriage to its alternative. I proceed without fully characterizing all possible dowry equilibria, and without precisely determining dowry prices, since neither of these inform the central argument here. There is, however, a substantial literature interested in precisely this question (see, for example, Becker 1991, Grossbard-Shechtman 1993, Chan and Zhang 1999, and Botticini and Siow 2000).

5. Increasing Population Equilibria

Suppose the economy is already in a stationary steady state, that is, prior to a starting period, denoted 0, the economy has experienced no population increase so that equal numbers of brides and grooms enter the marriage market each period. In period 0, there is an increase in population with the number of births of each sex rising from N to γN , where $\gamma > 1$.¹⁶ For a finite number of periods $0 < \tau \leq T$, the number of births, in each period, is greater than or equal to γN .

In periods 0 to $b - 1$, equal numbers of brides and grooms, N , continue to enter the marriage market. However in period b , brides born in period 0 reach marrying age so that γN brides enter the marriage market and seek matches with the N available men of age g . The number of grooms entering the marriage market does not increase to γN until period g . There is thus an excess supply of brides.

Unmatched brides in period b are allowed to re-enter the marriage market at age $b + 1$ in period $b + 1$. Thus in period $b + 1$, the average age of brides increases and correspondingly the marriage age gap between men and women marrying decreases. In later periods, this age gap continues to decrease as the excess supply of brides grows with population growth and an increasing number of older brides re-enter the marriage market.¹⁷

¹⁵The relationship between the income distribution across brides and equilibrium dowry payments is further discussed in Section 6.

¹⁶The marriage squeeze argument states that this increase in marriageable women is a function of reduced child mortality rather than increased births as modelled here; however, in this model, the distinction is irrelevant.

¹⁷This coincides with the results of Bergstrom and Lam (1991) who demonstrate that there is a large range

5.1. Equilibrium Dowry Payments

In this equilibrium some brides postpone their marriage, however, they do not delay marriage beyond that necessary for the marriage market to clear. This follows from the convex costs of delay assumption where, since older brides are willing to pay more than younger ones for a spouse, they always marry before younger brides. So far, this is in accordance with the marriage squeeze argument, older brides do outbid younger brides in equilibrium and as a result:

Lemma 1. *Older brides in the marriage market marry before the younger, and make higher dowry payments than younger brides in any period.*

The existence of older women in the marriage market in turn exacerbates the excess supply of younger potential brides (due to the population increase). One would thus expect that, as the marriage squeeze suggests, dowries must be inflating. The following proposition shows that this cannot be the case.

Proposition 2. *Under rational expectations, when there is a finite increase in the population: (i) dowry payments decrease for all aged brides; and (ii) average real dowry payments decrease even though the average age of brides increases when the population continues to grow.*

Proof of the above is in the appendix: Consider the decision facing a bride on whether to marry immediately or to wait. The equilibrium marriage payment must make her indifferent between marrying immediately, in period τ at age b , or marrying in period $\tau + 1$ at age $b + 1$. That is, (4.1) must hold with equality:

$$U(\tau, 0) = U(\tau + 1, 1). \quad (5.1)$$

Since delaying marriage incurs costs, $c(1)$, (5.1) implies that:

$$d(\tau, 0) = d(\tau + 1, 1) + c(1). \quad (5.2)$$

This condition simply says that to be willing to delay, brides who wait must pay lower dowries than those who marry as soon as possible. This incentive condition is depicted, by the downward sloping dotted line, in Figure 1 below, which plots dowry payments across time.

of population growth rates that can be supported, with no adjustments in the proportions of males and females marrying, by varying the age gap between spouses. Foster and Khan (1994) also derive a relationship between population increase and changes in age differential between spouses at marriage which is necessary to satisfy marriage market equilibrium.

Now consider the grooms' side. Since there are more brides than grooms of marriageable age, in any period $\tau + 1$, grooms marry brides of both ages. In equilibrium they must be indifferent between the two, that is condition (4.2) holds with equality:

$$V(\tau + 1, 0, 0) = V(\tau + 1, 1, 0) \quad (5.3)$$

which yields:

$$d(\tau + 1, 0) = d(\tau + 1, 1) - k(1). \quad (5.4)$$

This condition simply states that, within a period, older brides must make up for their age by paying higher dowries to grooms than younger brides. This condition is represented by the vertical dotted line in Figure 1:

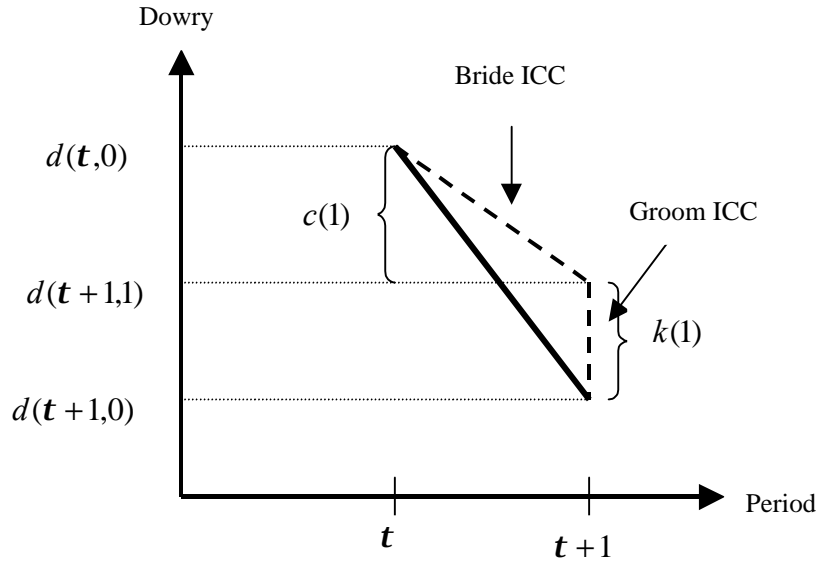


Figure 1 - Equilibrium dowry payments across time

The bold line in the figure above demonstrates that, as a result of these two incentive compatibility conditions, dowry payments can only be downward sloping. Similarly, equation (5.4), defined in period τ , and (5.2) yield decreasing dowry payments for brides of age $b + 1$ as well.¹⁸ Since

¹⁸The analysis ignores discounting because it is immaterial to the results. Dowry deflation occurs because there are costs to marrying older for brides. Discounting makes these costs lower but still positive. Including discounting in the model would imply that the difference in real dowry payments is: $d(\tau, 0) - \Delta d(\tau + 1, 0) = \Delta[k(1) + c(1)]$, where $d(\tau, 0) - \Delta d(\tau + 1, 0)$ is the real change in dowry payments across periods τ and $\tau + 1$ and Δ is the discount rate.

dowry payments must decline over time for all aged (b and $b + 1$) brides, average dowry payments also decline.

The analysis does not pin down a price before and after the population change, rather payments must remain within the bounds prescribed by (4.4). However, what is certain is that *in any equilibrium sequence of prices during periods when there is an excess supply of brides, dowry payments must decrease.*

What is central to the analysis is the existence of an excess supply of brides in the marriage market which is resolved by some brides postponing marriage until they are older, the manner in which this excess supply changes across periods being irrelevant. An expanding population only implies that the incentive conditions hold for a larger number of brides who are increasingly older. The dynamic model presented here is extremely simple, however, the main result of the paper will hold in any model where many individuals are making inter-temporal substitution decisions.

6. Robustness of the Result

In this section, I argue that the impossibility of the marriage squeeze argument yielding dowry inflation persists for all extensions of the simple model considered here.

The above result is independent of the income distribution of bridal family wealth. Under rational expectations, brides' parents take as given dowry payments in the final period. In the preceding period they offer a payment such that their daughters are indifferent to marrying in that period and postponing their marriage. Wealthier bridal parents can always outbid those who are poorer and marry their daughters at the desirable marriage age. However, they have no incentive to do so since they can achieve the same outcome by offering a dowry equivalent to what the poorest brides pay in a given period. Therefore the equilibrium time path of dowry payments is determined according to the income of the poorest bridal parents.¹⁹

Similarly, that older brides are always willing to outbid younger brides is due only to the convex costs to delay and is independent of the wealth of brides. When brides compete to determine which ones delay marriage, those with wealthier fathers can outbid those whose fathers are poorer. As a result, younger brides are on average richer than older brides. But younger brides can always afford

¹⁹ A related consideration is that the amount of dowry parents are willing to offer, relative to payments in the final period, is decreasing with population growth, due to an increase in the number of their daughters. This similarly will not alter the dowry deflation result. Rather equilibrium payments are only lower as the population continues to grow.

to outbid older brides (because younger women are more desirable to grooms, they can compete with those older by offering a lower price, even when their wealth is identical), rather it is not worthwhile for them to deviate from the equilibrium outcome given equilibrium prices. Therefore, the wealth distribution across older and younger brides is irrelevant to Lemma 1.

Additionally it is straightforward to show that a changing wealth distribution similarly has no implications for the dowry deflation result. If bridal wealth is increasing across periods, then in each period τ , younger brides are on average richer than older brides. As just discussed, it is never worthwhile for younger brides to outbid older brides, and hence, within each period, dowry payments are determined with respect to the wealth of the older brides. Therefore, increasing the wealth of younger brides across time could render payments in the subsequent period higher than they would have been in the case of constant wealth, but as long as brides delay marriage, the decreasing time path of dowry payments ensues, thus only the rate of decline may alter.

That women postpone marriage in response to population growth is the focus of this paper, since it is this phenomenon which is occurring in areas undergoing dowry inflation. It is alternatively conceivable that in period b , the excess supply of brides match with younger grooms, aged $g - 1$. In this scenario, it is easily demonstrated that the result of dowry deflation also ensues. In this case, the costs to grooms of delay matter and dowry payments are denoted $d(\tau, t, i)$. Grooms younger than g are less desirable and in equilibrium, $d(\tau, 0, -1) < d(\tau, 0, 0)$.²⁰ Grooms receive a payment such that they are indifferent to marrying at age $g - 1$ and at age g in the subsequent period. Assuming there are no delay costs to grooms for waiting until the desirable age to marry, then in equilibrium, $d(\tau, 0, -1) = d(\tau + 1, 0, 0)$. These two conditions imply $d(\tau + 1, 0, 0) < d(\tau, 0, 0)$ and hence dowry payments decrease once again.²¹

If the population increase is initially unanticipated in period b , a jump in dowry payments in that period is possible and condition (4.4) would not hold. But there will still be dowry deflation after that. As long as individuals' expectations adapt to the existence of a surplus of brides thereafter, new unanticipated increases in the population will not alter the decreasing time path of equilibrium

²⁰If grooms younger than g were not less desirable in the marriage market there would be no rationale for why g is the marriageable age of grooms. This would be expected if the ideal age for grooms, g , depends on the time when men have completed their education and entered employment or are prepared to take on household responsibilities.

²¹Alternatively, suppose there are costs to grooms marrying earlier than g , hence $d(\tau, 0, -1) > d(\tau + 1, 0, 0)$. Brides are either indifferent between different aged grooms or prefer those at the desirable age: $d(\tau, 0, -1) \square d(\tau, 0, 0)$, hence again $d(\tau + 1, 0, 0) < d(\tau, 0, 0)$.

dowry payments. This is because additional increases (anticipated or unanticipated) only imply that the equilibrium incentive conditions hold for a larger number of brides and do not influence the expectations of brides, i.e., that they may have to postpone their marriage because of population growth.

Alternatively, consider that the mechanism which determined dowry payments in the no population growth case alters with population growth. In particular, suppose that when population growth creates an excess supply of brides, grooms are able to bargain for the entire marriage surplus and dowry payments rise. Once again, we could observe an initial jump in dowry payments, however, thereafter dowry payments must decline, even when the population continues to grow, as long as some brides postpone marriage, for then, the reasoning of Section 5 again applies.

To focus on the marriage squeeze argument, the analysis assumes that from the perspective of brides, grooms are homogeneous. If instead, grooms were ranked by brides according to their quality (or potential wealth, for example), the main result would also still hold. In the no population growth equilibrium, wealthier brides would match with higher quality grooms, who would receive higher dowry payments than those of lower quality. The intuition for how dowry payments change when population growth creates an excess supply of brides remains the same as above, where brides of a given wealth level compete within their own sub-group (i.e., for a given quality groom) to determine which brides postpone their marriage until the subsequent period. This follows because a given bride has no incentive to outbid poorer brides, to marry a lower quality groom in a given period, rather than postponing her marriage to marry a higher quality groom for a lower dowry price in a subsequent period. Therefore, similar inter-temporal incentive constraints to before hold for all brides in equilibrium and, as a result, dowry deflation will ensue for each quality groom. Average dowry payments again decrease across time.

The above result is altered if instead we consider an infinite increase in population. In this case, the excess supply of brides continues to grow and in later periods, older brides re-enter the market at an increasing rate and at higher ages. However, the age of the emerging older brides into the market can never exceed the age of grooms, g . In time, when brides of age g do enter the marriage market, the number of brides of age g is less than the number of grooms of age g , since they reflect the surplus of brides in the marriage market of age $g - 1$ in the preceding period. Because the population of brides and grooms of age g is growing at the same rate, the number of brides of age

g never catches up to the number of grooms of the same age. Grooms of age g , therefore, continue to match with brides of age g and those younger, and in effect, a steady state equilibrium where only brides and grooms of the same age match is never reached in the context of a permanently increasing population.

Since the marriage market does not eventually reach a steady state, there is always an excess supply of potential brides. If real dowry payments can only decrease across periods when some brides are postponing marriage, then in this context they will always decrease. However, a perpetually declining path of dowry payments cannot constitute an equilibrium price trajectory since dowry payments must satisfy the participation constraints of both brides and grooms. These prices would eventually arrive at the lower bound, where at such a price, grooms are indifferent to either marrying or remaining single. At this point, brides would prefer to offer a higher payment rather than remain unmarried. But this higher payment would, in turn, increase all prior payments if constraints (5.1) and (5.3) hold. Thus any path of decreasing payments is inconsistent. Similarly, an increasing path of dowry payments is also inconsistent, as (5.1) must hold in equilibrium if some brides postpone marriage. It is easily demonstrated, that these conditions imply that in the infinite population growth case, the only equilibrium is a spot market equilibrium, where only brides of age b match, the average age of brides remains constant, and there is an increasing number of unmarried women. As already discussed, the implications of such an equilibrium conflict with empirical fact. That is, the average age of brides increasing and all brides eventually marrying. In any case, it once again does not give rise to the possibility of dowry inflation.

7. Conclusion

The “marriage squeeze” is a demographic phenomenon that relates population growth to a reduction in the age difference between brides and grooms. The aim of this paper was to understand how this process relates to dowry inflation. Extending the essentially static explanation into a dynamic framework was argued to be necessary, but it gives rise to difficulties in making the theory reconcile observations relevant to population growth. The framework used was built only on assumptions which had been previously thought necessary for dowry inflation to occur with rising population; that is, men marrying younger women, and there being costs for women marrying later than the optimal age. For this same framework to be consistent with two observed facts - a decrease in

the age difference between spouses with population growth, and all men and women eventually marrying - it was shown that dowry deflation must occur. It would seem, in conclusion, then, that population change is not a promising explanation of increasing dowry payments.

8. Appendix

Proof of Lemma 1:

In any given period, older brides are willing to pay more than those younger for a given groom. To demonstrate this, suppose the contrary; that an unmatched bride aged $b + t_1$ in period τ offers a deviation payment so as to outbid an older bride aged $b + t_2$, where $0 \leq t_1 < t_2$, thus forcing the latter to marry in period $\tau + 1$ at age $b + t_2 + 1$. The highest payment the $b + t_2$ bride is willing to pay is such that she is indifferent to marrying in periods τ or $\tau + 1$. This is the case if the following holds:

$$U(\tau, t_2) = U(\tau + 1, t_2 + 1) \quad (8.1)$$

and hence,

$$d(\tau, t_2) + c(t_2) = d(\tau + 1, t_2 + 1) + c(t_2 + 1). \quad (8.2)$$

In period $\tau + 1$, grooms will marry these older brides of age $t_2 + 1$ if they offer a dowry so that grooms are no worse off matching with them relative to those younger. The lowest payment which will attract grooms to these less desirable brides (of age $b + t_2 + 1$) is such that grooms are indifferent to them and those younger:

$$V(\tau + 1, t, 0) = V(\tau + 1, t_2 + 1, 0) \quad (8.3)$$

for $0 \leq t < t_2 + 1$, which implies:

$$d(\tau + 1, t) - k(t) = d(\tau + 1, t_2 + 1) - k(t_2 + 1). \quad (8.4)$$

for $0 \leq t < t_2 + 1$. Equations (8.2) and (8.4) yield:

$$d(\tau, t_2) = d(\tau + 1, t) + k(t_2 + 1) - k(t) + c(t_2 + 1) - c(t_2). \quad (8.5)$$

The payment $d(\tau, t_2)$ of (8.5) reflects the dowry payment a bride of age $b + t_2$ in period τ is willing to pay to marry in that period rather than the subsequent one. Younger brides can outbid these older brides with a lower payment than $d(\tau, t_2)$ because they are preferred by grooms. The smallest deviation payment they can make solves (4.2) with equality for t_1 and t_2 :

$$V(\tau, t_1, 0) = V(\tau, t_2, 0) \quad (8.6)$$

which implies the deviation payment $d^*(\tau, t_1)$ solves:

$$d^*(\tau, t_1) - k(t_1) = d(\tau, t_2) - k(t_2) \quad (8.7)$$

Substituting (8.5) for $t = t_1 + 1$ into (8.7):

$$d^*(\tau, t_1) = d(\tau + 1, t_1 + 1) + k(t_2 + 1) - k(t_1 + 1) + c(t_2 + 1) - c(t_2) \quad (8.8)$$

Suppose instead that younger brides delay marriage rather than outbidding older brides in period τ . Dowry payments in period τ will be bid up to the point where brides aged $b + t_1$ are indifferent to marrying across these two periods, that is, (4.1) must hold with equality. This implies:

$$d(\tau, t_1) = d(\tau + 1, t_1 + 1) + c(t_1 + 1) - c(t_1). \quad (8.9)$$

Because of the convexity in delay costs; $c(t_2 + 1) - c(t_2) > c(t_1 + 1) - c(t_1)$, and clearly since $k(t_2 + 1) - k(t_1 + 1) > 0$, then $d^*(\tau, t_1)$ is greater than $d(\tau, t_1)$. Therefore offering the dowry

payment $d^*(\tau, t_1)$ only makes a bride worse off and is not a worthwhile deviation. As a result younger brides do not outbid older brides for grooms and in each period all older brides marry. ■

Proof of Proposition 2 Part (i):

When the population continues to increase, potentially older brides re-enter the marriage market at an increasing rate and at higher ages. Denote the entry period of a bride aged $b + t$ by p_t , this implies that the supply of brides aged $b + t - 1$ (who were the oldest brides in the market) exceeded that of grooms in period $p_t - 1$. If the supply of brides aged b begins to decline, that of grooms continues to grow for an additional $g - b$ periods. If this is the case, when the relative supply of brides begins to fall, gradually the excess supply of brides decreases and in turn the age of the oldest brides in the market falls. Denote the last period before brides of age $b + t$ cease to exist in the marriage market by f_t . When T is finite, the marriage market returns to a steady state (all brides marry at age b and all grooms marry at age g) after period $T + g$ at which point the excess supply of brides has been equalized by the relatively high supply of grooms.

Let $b + m$ reflect the oldest age of brides reached during periods $b < \tau < T + g$, necessarily $0 \leq m \leq g - b$, (since the age of brides cannot exceed that of grooms because the population of brides and grooms of age g is growing at the same rate). Incentive condition (5.1) implies:

$$d(\tau, s) + c(s) = d(\tau + 1, s + 1) + c(s + 1) \quad (8.10)$$

for $p_{s+1} - 1 \leq \tau < p_{s+2} - 1$ and $f_{s+2} \leq \tau < f_{s+1}$, where $1 \leq s < m - 1$. Using (5.3) this becomes,

$$d(\tau, s) - d(\tau + 1, s) = c(s + 1) - c(s) + k(s + 1) - k(s). \quad (8.11)$$

Condition (5.3) further implies that

$$d(\tau, t) - k(t) = d(\tau, s) - k(s) \quad (8.12)$$

for $0 \leq t < s$, thus implying that

$$d(\tau, t) - d(\tau + 1, t) = c(s + 1) - c(s) + k(s + 1) - k(s) \quad (8.13)$$

for $p_{s+1} - 1 \leq \tau < p_{s+2} - 1$ and $f_{s+2} \leq \tau < f_{s+1}$, where $1 \leq s < m - 1$ and $0 \leq t \leq s$.

Assuming dowry payments in the final period $d(T + g, 0) = \tilde{d}$, then dowry payments for all brides marrying in the preceding period are equal to $d(T + g - 1, t) = \tilde{d} + k(t)$. Solving backwards, for periods $f_2 \leq \tau < T + g - 1$:

$$d(\tau, t) = \tilde{d} + (T + g + 1 - \tau)[k(1) + c(1)] + k(t) \quad (8.14)$$

For all periods $f_{s+2} \leq \tau < f_{s+1}$, where $1 \leq s < m - 1$:

$$\begin{aligned} d(\tau, t) &= \tilde{d} + (T + g + 1 - \tau)[k(1) + c(1)] + k(t) \\ &\quad + \sum_{i=2}^s (f_i - f_{i+1})[k(i) - k(i - 1) + c(i) - c(i - 1)] \\ &\quad + (f_{s+1} - \tau)[k(s + 1) - k(s) + c(s + 1) - c(s)] \end{aligned} \quad (8.15)$$

Similarly for period $p_m < \tau \leq f_m$ dowry payments are equal to:

$$\begin{aligned} d(\tau, t) &= \tilde{d} + (T + g + 1 - \tau)[k(1) + c(1)] + k(t) \\ &\quad + \sum_{i=2}^{m-1} (f_i - f_{i+1})[k(i) - k(i - 1) + c(i) - c(i - 1)] \\ &\quad + (f_m - \tau)[k(m) - k(m - 1) + c(m) - c(m - 1)] \end{aligned} \quad (8.16)$$

For periods $b+1 \leq \tau \leq p_m$, the derivation of equilibrium dowry payments is not as straightforward. Without loss of generality, however, they can be represented for periods $p_s < \tau \leq p_{s+1}$, for $1 \leq s \leq m-1$, by:

$$\begin{aligned}
d(\tau, t) = & \tilde{d} + (T + g + 1 - \tau)[k(1) + c(1)] + k(t) \\
& + \sum_{i=2}^{m-1} (f_i - f_{i+1})[k(i) - k(i-1) + c(i) - c(i-1)] \\
& + (f_m - p_m)[k(m) - k(m-1) + c(m) - c(m-1)] \\
& + \sum_{i=s+1}^m \{(p_i - 1 - p_{i-1})[k(i-1) - k(i-2) + c(i-1) - c(i-2)] + c(i) - c(i-1)\} \\
& + (p_{s+1} - 1 - \tau)[k(s) - k(s-1) + c(s) - c(s-1)] + c(s+1) - c(s) - (t) \quad (8.17)
\end{aligned}$$

where $-(t)$ is increasing in t . Equations (8.14), (8.15), (8.16), and (8.17) imply that in all periods $d(\tau, t)$ is decreasing in τ and increasing in t . ■

Proof of Proposition 2 Part (ii):

Let n_g^τ denote the number of grooms in period τ , then the brides which marry in each period are the n_g^τ oldest. In period $p_t - 1$, for $1 \leq t \leq m$, the supply of brides into the marriage market is such that only brides aged $b+t-1$ find matches. In periods p_t through to $p_{t+1} - 2$, both brides of age $b+t-1$ and $b+t$ marry. Average dowry payments in periods $0 \leq \tau \leq p_m$ can then be characterized as:

$$D(\tau) = \alpha_{t-1}^\tau d(\tau, t-1) \quad (8.18)$$

for $\tau = p_t - 1$ and

$$D(\tau) = \alpha_{t-1}^\tau d(\tau, t-1) + \alpha_t^\tau d(\tau, t) \quad (8.19)$$

for $p_t \leq \tau \leq p_{t+1} - 2$ and $0 \leq t \leq m$ where α_t^τ is the proportion of brides of age $b+t$ marrying in period τ , i.e. $\alpha_t^\tau = \frac{n_t^\tau}{n_g^\tau}$, where n_t^τ is equal to the number of brides of age $b+t$ who marry in period τ . Necessarily $\alpha_t^\tau + \alpha_{t-1}^\tau = 1$. If $D(\tau)$ is defined as in (8.18) then

$$D(\tau+1) = \alpha_{t-1}^{\tau+1} d(\tau+1, t-1) + \alpha_t^{\tau+1} d(\tau+1, t) \quad (8.20)$$

If $D(\tau)$ is defined as in (8.19) then either

$$D(\tau+1) = \alpha_{t-1}^{\tau+1} d(\tau+1, t-1) + \alpha_t^{\tau+1} d(\tau+1, t) \quad (8.21)$$

if $p_t \leq \tau+1 \leq p_{t+1} - 2$ or

$$D(\tau+1) = \alpha_t^{\tau+1} d(\tau+1, t) \quad (8.22)$$

if $\tau+1 = p_{t+1} - 1$. Given equations (8.10) and (8.13), it is clear that the dowry payments which comprise $D(\tau)$ are necessarily all larger than the payments which constitute $D(\tau+1)$. Using the fact that $\alpha_t^\tau + \alpha_{t-1}^\tau = 1$ and $\alpha_t^{\tau+1} + \alpha_{t-1}^{\tau+1} = 1$ then $D(\tau) > D(\tau+1)$ for $1 \leq \tau < p_m$.

In periods $\tau \geq p_m$, the supply of grooms is still growing, although the supply of brides of age b has returned to its steady state level. As a result for $\tau \geq p_m$, as τ increases older brides gradually leave the market. Furthermore, it is possible that for $f_t \leq \tau < f_{t-1}$:

$$D(\tau) = \alpha_{t-1}^\tau d(\tau, t-1) + \alpha_t^\tau d(\tau, t) \quad (8.23)$$

and

$$D(\tau + 1) = \alpha_{t-2}^{\tau+1}d(\tau + 1, t - 2) + \alpha_{t-1}^{\tau+1}d(\tau + 1, t - 1) + \alpha_t^{\tau+1}d(\tau + 1, t) \quad (8.24)$$

where $\alpha_{t-2}^{\tau+1} + \alpha_{t-1}^{\tau+1} + \alpha_t^{\tau+1} = 1$. That is, for $\tau \geq p_m$, as τ increases, older brides are gradually leaving the marriage market while younger brides are again marrying. Therefore $D(\tau)$ is similarly comprised of dowry payments larger than those of $D(\tau + 1)$, and by the same reasoning as above, $D(\tau) > D(\tau + 1)$ for $p_m \leq \tau < T + g$. ■

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